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Responses To Comments

from CDH, EPA, AND PRC

on

Technical Memorandum No. 1
Exposure Assessment
Human Health Risk Assessment
(Draft Final, January 15, 1993)

for

Operable Unit No. 7
Present Landfill (IHSS 114),
The Inactive Hazardous Waste Storage Area (IHSS 203),
and The East Landfill Pond Area and
Adjacent Spray Evaporation Areas

prepared for

U.S. Department of Energy
Rocky Flats Plant
Golden, Colorado

prepared by

EG&G Rocky Flats, Inc.
Golden, Colorado

April 22, 1993

GENERAL RESPONSES TO COMMENTS

This document presents DOE's responses to comments provided by the Colorado Department of Health (CDH), U.S. Environmental Protection Agency (EPA), and EPA's consultant PRC on Technical Memorandum No.1, Exposure Scenarios, as part of the Human Health Risk Assessment for OU 7, Present Landfill, at Rocky Flats. This section of the document contains general response summaries for some of the more frequent or fundamental comments. Specific responses to individual comments from CDH, EPA, and PRC are provided in subsequent sections of the document. More detailed information supporting the DOE positions outlined below is provided in the specific comments.

I. Demographic Data

Many of the early comments criticize the use of the DOE (1990) document, titled *1989 Population, Economic, and Land Use Data for Rocky Flats Plant*. The primary objection appears to be that the use of that report, much of which is derived from 1980 census data, results in reliance on outdated or incorrect data. Actually, many of the projections described in DOE (1990) are based on actual rather than projected demographic information, such as population growth rates and, in some cases, revised population estimates. More importantly, it should be remembered that the DOE (1990) was used only as a basis for qualitatively evaluating potential land use scenarios and exposure receptors. Regardless of the accuracy or inaccuracy of data derived from DOE (1990), DOE believes that the receptors selected, and especially those retained for quantitative evaluation, are conservative and protective of human health.

II. Credible versus Improbable Exposure Scenarios

The purpose of evaluating the likelihood of specific land use (and thus exposure) scenarios occurring onsite or offsite in the future is to provide the risk manager, and others reading or using the risk assessment, with realistic information on potential overall impacts. It is not an attempt to avoid performing a quantitative assessment for any given scenario. Moreover, DOE believes that the scenarios retained for quantitative assessment are both reasonable and conservative, and that the approach utilized is consistent with recent EPA guidance (Habicht,

H.F. II, 1992, Memorandum to Assistant and Regional Administrators: Guidance on Risk Characterization for Risk Managers and Risk Assessors. February 26).

III. Ecological Researcher Scenario

In developing exposure assumptions for a potential ecological researcher scenario, DOE is attempting to be conservative but reasonable exposure. The assumptions used in this scenario were developed based on input from various sources, including Dr. Ward Whicker of Colorado State University, who has conducted considerable research at RFP and elsewhere. Ecological research includes a combination of field work, laboratory work, and office work; collecting samples or making observations at the site are typically not full-time efforts. Agency comments would tend to drive this scenario toward identical to the future onsite office worker. DOE believes that this approach would be neither realistic nor appropriate.

IV. Landfill Worker

There appears to be some confusion concerning the use of health and safety data in the risk assessment. A risk estimate will be provided for the current onsite landfill worker and a future onsite construction worker based on reasonable, conservative assumptions. Exposure and risk estimates will be calculated in the risk assessment, and these data will be compared to current Occupational Safety and Health Administration (OSHA) guidelines for informational purposes only.

V. Reasonable Maximum Exposure (RME)

When providing risk estimates for a hazardous waste site, the objectives and guidelines provided by EPA are to define a conservative but reasonable estimate, usually the 95th percentile of maximum probable risk. (See EPA 1991b, Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual. Supplemental Guidance, "Standard Default Exposure Factors." OSWER Directive 9285.6-03, Page 2.) (Also see Federal Register, Volume 57, Number 104, Page 22922, Friday, May 29, 1992.) Because the derivation of the risk estimates are a combination of many different individual assumptions, the use of the most conservative value for each assumption may lead to an estimate of exposure (and risk) that is unreasonable

and far above the 95th percentile. The assumptions provided by DOE are consistent with a conservative but reasonable approach and with agency guidance.

VI. Plant Uptake Offsite

DOE continues to believe that estimating risk due to plant uptake offsite is unreasonable because of the extreme dilution associated with aerial transport and mixing throughout the root zone. Conservative estimates of dilution as a result of Gaussian dispersion to an offsite garden, coupled with tilling of the top 15 cm of the garden soil, result in a dilution factor of at least 60,000 following 30 years of deposition. Therefore, the additive exposure associated with plant uptake from the soil (compared to deposition of foliar parts) is insignificant. However, DOE will evaluate uptake of contaminants through plant roots in conjunction with the onsite residential garden scenario.

VII. Fraction Ingested (FI) Values

The current literature regarding the relative contribution of outdoor soil to indoor dust is inconclusive. DOE assumes that, even for individuals who spend all of their time at home, only half of the ingested soil or dust originates as contaminated media. The other half includes dust from more distant sources, as well as a variety of indoor sources unrelated to outdoor soils. Therefore, DOE will use an FI value of 0.5.

VIII. Childhood Exposure Calculations

Except for the ingestion of soil, for which intake during childhood is significantly higher than for adults, DOE does not believe that it is appropriate to evaluate children as a separate receptor subpopulation. The bases for this determination include (1) the lack of specific guidance on other intake rates for children, (2) the lack of benchmark toxicity values for characterizing risks associated with subchronic exposures, and (3) the possibility that the available benchmark inhalation toxicity values (RfCs) already incorporate an adjustment to protect for childhood intakes.

IX. Ingestion of Vegetables

The ingestion of vegetables from onsite gardens is being considered as an exposure pathway. The vegetable ingestion rate for one year will be incorporated in the risk assessment. Realistically, however, any individual who preserves vegetable products by canning or freezing will certainly wash them first. DOE believes that this is also true for an individual who consume most of their total vegetable intake from their own garden (as opposed to someone who may eat an occasional tomato from a backyard garden). DOE will therefore apply a soil washoff factor for the onsite and offsite residential garden scenarios.

RESPONSES TO COLORADO DEPARTMENT OF HEALTH COMMENTS

Comment 1. **Sections 2.5.2 and 2.6.3** The statements that sandstones may not subcrop beneath the East Landfill Pond (page 2-19) and that the pond does not directly discharge surface water to the drainage downgradient (page 2-24) are preliminary. Conclusions on these subjects could be reached after the current OU 7 investigations have been completed. The first statement (page 2-19) should be specifically referenced.

Response: The statements on page 2-19 and 2-24 are taken directly from the Phase I RFI/RI Work Plan and will be referenced as requested.

Comment 2. **Section 3.0** The DOE 1990 reference cited throughout this section of the document uses 1980 census data. Census data for 1990 has been available for some time and should be incorporated into this document.

Response: See General Response I. The 1989 (DOE 1990) document was used for consistency with other risk assessments at RFP. Although that document was based on 1980 data, actual growth rates and more recent population estimates were used as the basis for projections into the future. It is therefore incorrect to characterize the data presented in the technical memorandum as being based on outdated information. Furthermore, the data were not relied upon for either quantitative purposes or as a basis for eliminating a potential exposure scenario from consideration. DOE will continue to reference the 1989 document but will use more recent demographic information where appropriate in preparing the revised technical memorandum. Updated data will be included for OU 7 after review and approval by EPA and CDH of similar revisions in the technical memorandum for OU 3. However, it is important to remember that the census data are used only to establish a qualitative framework for describing future land use scenarios. Moreover, the assumption of residences with gardens at the RFP fenceline along Woman Creek and Walnut Creek conservatively address the agricultural issue.

Comment 3. **Section 3.1** Again, using a 1989 population projection from 1980 data is not acceptable. In addition, the estimate of zero population growth in the area immediately adjacent to the plant boundary is highly suspect given the change in plant mission.

Response: See General Response I. Recent land use surveys conducted for OU 3 also indicate a preponderance of open space and commercial/industrial land uses adjacent to RFP in the downwind direction. The revised technical memorandum will address the anticipated residential growth in the areas between Indiana Street and Standley Reservoir and east of Great Western Reservoir. Both of these areas will be conservatively represented by hypothetical residential receptors at the RFP fenceline in the predominant downwind direction (east-southeast) along Woman Creek and at the closest offsite location along Walnut Creek.

Comment 4. **Section 3-1** A map should be provided showing the locations of the schools, hospitals, and nursing homes within a 10-mile radius of RFP, which are mentioned on page 3-4.

Response: Development and inclusion of such a map would not add to the technical memorandum. Future onsite and offsite receptors depicted in Figure 3-7 have been selected at the direction of the agencies as being appropriate and conservative.

Comment 5. **Figure 3-1** This figure should be updated to reflect 1990 census data.

Response: The effort required to research and incorporate the 1990 census data is not justified for this technical memorandum, given the fact that the data are not used as a basis for quantitative exposure calculations or as a basis of eliminating potential exposure scenarios (see response to General Comment I). Therefore, this figure will be retained for consistency with other risk assessments performed for RFP.

Comment 6. **Figure 3-2** This figure should be updated to show projections which reflect 1990 census data.

Response: See response to Comment 5.

Comment 7. **Table 3-1** This table should be updated to reflect 1990 census data.

Response: See response to Comment 5.

Comment 8. **Figure 3-3** This map is not readable and therefore is of little use.

Response: We believe that a land use map is useful for the technical memorandum. Therefore, an improved and updated version of Figure 3-3 will be included in the revised document.

Comment 9. **Section 3.2.1** The last sentence on the bottom of page 3-4 should be changed to read "The northeastern Jefferson County and RFP area *includes* one of the most...."

Response: The meaning of the sentence is more accurately reflected by the present language than the suggested revision. However, we would agree that the sentence may over-emphasize the present or expected future extent of industrialization in the area surrounding RFP, and we will therefore delete it.

Comment 10. **Table 3-2** The zoning code "M-C" should be explained on page 3-11 following this table.

Response: Agreed.

Comment 11. **Section 3.2.2** Industrial land-use will probably not "dominate" future land-use in northeastern Jefferson county as stated in the first paragraph, particularly given the plant mission change and the pace of residential development in the area.

Response: The paragraph accurately summarizes what was projected by Jefferson County in their 1989 document and thus is correct as written. However, we agree that recent changes in the mission of RFP may result in changes in the pattern and prevalence of land use. Other activities that may affect future land use will also be discussed. Examples include possible developments such as the Jefferson Center, W-470, Jefferson County Airport expansion, and Tucker Lake Golf Course expansion and their potential influence on future land use in the area east of RFP.

Comment 12. **Section 3.2.2** The third and fourth paragraphs in this section do not accurately represent the facts. W-470 is no longer an issue since this project is currently defunct, only a small percentage of the area is industrial, zoning does not allow for heavy industry, and the plant's mission has changed.

Response: See response to Comment 11. Although W-470 is currently "dead", the continued growth in northeastern Jefferson County and southeastern Boulder County correctly noted in an earlier CDH comment make its resurrection possible.

Comment 13. **Section 3.2.2** The third paragraph on page 3-4 uses outdated information from the same report (DOE, 1990) mentioned earlier. Plant mission and community perceptions have changed.

Response: We do not see anything in the referenced paragraph that would be affected by more recent census data, except perhaps for the number of people serviced by the City of Broomfield's water treatment plant east of Great Western Reservoir. We will verify the number and revise it if appropriate. We suspect that the comment was meant to address the third paragraph on page 3-13. We will revise this paragraph as follows, beginning halfway through the first sentence:

Future land use east, southeast, and south of RFP is expected to consist mostly of open space and commercial/industrial, with smaller areas of mixed commercial/rural residential. Suburban residential developments are expected to occur farther east, probably at least 2 miles from RFP. The timing for transition of some existing agricultural lands to open space is not known.

Comment 14. **Section 3.2.2** The last paragraph in this section is also inaccurate. Current land use in the immediate vicinity of RFP is <u>not</u> primarily commercial/industrial. It is predominantly low density agricultural and residential which can be seen on the land use map and Table 3-2 in this document.

Response: This paragraph will be deleted.

Comment 15. **Section 3.3.2** On page 3-17, the text states that "use of onsite production facilities by private industry is planned for the future at RFP." This issue should be revisited in light of potential changes brought about by the new administration and new Energy Secretary. Also, there are many inherent problems with private industry using portions of RFP that DOE has been unable to coherently address at this time.

The Rocky Flats Local Impacts Initiative (RFLII) is not "working to achieve" private industry use of RFP. They are evaluating this as one option to minimize economic impacts to the surrounding communities from the changing plant mission.

Issues raised in this section should be clarified by knowledgeable DOE sources. This information should not be coming from the cited sources (*Denver Post, Boulder Daily Camera*, RFLII).

Response: The text will be modified to present the range of future land use options currently being discussed for RFP. Furthermore, the

preceding text in this section, which references DOE (1980) and DOE (1992), will be rewritten as historical background and to reflect that the fourth bullet at the top of page 3-17 (Alternative 3) has proven to be the correct scenario. However, we believe that it is appropriate to describe DOE's former position relative to use of portions of the RFP industrial area by private industry, as expressed by Admiral Watkins, because the present Secretary has not yet expressed a different position.

Comment 16. **Section 3.3.2** At the top of page 3-18, it states that the buffer zone is being considered as a potential ecological preserve. What the text does not state, but needs to, is that this is only one of several potential uses under consideration. In light of the mission change, many more land use options have become viable.

Response: While we agree that the full range of currently viable options for future onsite land use should be mentioned (see response to Comment 15), we believe that the referenced text concerning possible establishment of some type of ecological preserve in the buffer zone is appropriate. Certainly the ecological preserve and private industrial park options have received the greatest attention to date and thus would appear to be more likely at this time than residential or agricultural options.

Comment 17. **Section 3.3.2** The paragraph at the middle of page 3-18 states that extensive development of the area is unlikely. Again, mission change has made this statement less certain.

Response: The last sentence of this paragraph will be deleted.

Comment 18. **Section 3.3.2** The final sentence of this section is entirely wrong for the previously stated reasons.

Response: This last sentence of this section will be deleted.

Comment 19. **Section 3.4** The first paragraph in this section states that "EPA guidance does not require an exhaustive assessment of every potential receptor and exposure scenario." While this may be true, all potential receptors must still be identified and compared to determine the likelihood of harm.

Response: See General Response II. The first paragraph in this section will be revised to read as follows:

Current and future human population groups on and near the site are potential candidates for evaluation based on their likelihood of exposure to site-related chemicals of concern. EPA guidance does not require an exhaustive assessment of every potential receptor and exposure scenario (EPA 1992a). Rather, the highest potential exposures that are reasonably expected to occur (reasonable maximum exposures) should be evaluated, along with an assessment of any associated uncertainty (EPA 1989a). However, all potential receptors will be identified and evaluated to determine if important exposure pathways or receptors have been overlooked.

Comment 20. **Section 3.4** Future onsite residential uses are <u>not</u> inconsistent with planned offsite industrial and commercial development. The RFP buffer zone is very large and could easily allow both residential and industrial/commercial land-uses to co-exist. Residential developments are the predominant land-use offsite and are increasingly encroaching on the immediate borders of the buffer zone. The Standley Lake-Louisville-Superior residential area is one of the fastest growing portions of the Denver-Metro area. Water resources are presently not a limiting factor for development and are not anticipated to be in the future. Given the change in plant mission, future onsite residential developments are no longer "improbable." Whether residential land-use is consistent with outdated DOE plans is no longer relevant.

Response:

See response to Comment 19. In addition, the remainder of this section will be revised for consistency with revisions in Section 3.3, described previously. The proposed revised text, beginning with the second paragraph of Section 3.4, is as follows:

The current and expected future land-use patterns for offsite and onsite areas are described in Sections 3.2 and 3.3, respectively. For the purpose of a qualitative evaluation of potential receptors, future land-use scenarios have been categorized as either improbable (unlikely to occur because of serious constraints) or credible (expected to occur given the right set of circumstances). Table 3-3 presents the probability classification for the five major future land use categories (residential, commercial/industrial, recreational, ecological reserve, and agricultural).

3.4.1 Improbable Future Land Uses

Future land uses considered to be improbable include onsite residential, onsite agriculture, offsite agricultural, and offsite ecological reserve. Both onsite agriculture and onsite residential are considered improbable because of the increasing public interest in preserving unplowed prairie and wetland habitats and protecting wildlife. This is evidenced by ongoing acquisition of open space by Jefferson County, Boulder County, and the City of Boulder (including large tracts near RFP) and the recent designation of the Rocky Mountain Arsenal as a wildife refuge by the U.S. Fish and Wildlife Service. Like RFP, the Arsenal is a large (27-square mile) RCRA/CERCLA site that was protected from grazing or development because of weapons production and the need for an extensive buffer zone. Additionally, agriculture would offer poor economics compared to commercial/industrial development.

Offsite agriculture is considered to be less likely than residential, commercial/industrial, or recreational uses because of economics as well as increasing public and community interest in preserving open

space. This is also consistent with existing regional zoning and land use designations, as discussed in Section 3.2 of the technical memorandum and shown on the figures included in that section. Therefore, although agriculture currently occurs in nearby offsite areas, it is anticipated that this use will gradually diminish and eventually disappear from parcels closest to the site.

Use of offsite areas as ecological reserves is considered improbable because of the disturbed nature of most parcels (cultivation or heavy grazing) and the proximity to planned commercial/industrial or mixed commercial/residential uses. Exceptions might be stands of cottonwoods near Standley Reservoir, where bald eagles were observed in the winter of 1992-93.

3.4.2 Credible Future Land Uses

Future onsite land uses considered to be credible include commercial/industrial, recreational, and ecological reserve. Commercial/industrial uses would be appropriate, at least for the present industrialized area of RFP, because of the existing infrastructure, economic advantages, and reduced liability concerns. Onsite recreational and ecological reserves would be consistent with the ecological diversity and scenic quality of the site, the existing wildlife use and presence of several species of special concern, the increasing regional interest in habitat preservation and undeveloped recreation, and minimal liability issues.

Credible future offsite uses include commercial/industrial, residential, and recreational. All these are consistent with recent growth and development patterns in the northwestern Denver metropolitan area and are projected in various planning documents (see Section 3.2).

Comment 21.

Section 3.4 The paragraph beginning in the middle of page 3-21 states that "future offsite agricultural land uses are identified as plausible,"

but the rest of the sentence is inconsistent with that statement. In exposure scenario technical memoranda for other OUs, this sentence is finished by stating "although such an activity is expected to decrease in the future."

Response: This inconsistency will be corrected. Offsite agriculture is considered to be improbable. See response to Comment 20.

Comment 22. **Section 3.5** The proposal to aggregate data on an operable unit basis rather than an IHSS specific basis (bottom of page 3-22) is unacceptable since it precludes consideration of hot spot exposures as required by RAGS. IHSSs should be evaluated separately so that any contamination at each site can be dealt with more effectively. If data from hotspots is combined with that from potentially uncontaminated areas in OU 7, potential contaminants could be "diluted out," and the resulting risk would be underestimated.

Response: Hot spots will be dealt with as discussed and agreed upon in the RFI/RI comment resolution process for OU 1 (881 Hillside).

Comment 23. **Table 3-4** Section 3.3.1 on page 3-16 states that, "Current activities within OU 7 include environmental investigations and routine security surveillance." However, Table 3-4 indicates that current ecological reserve land use scenarios will not be considered. What is the justification for not including a current ecological researcher scenario? This scenario would likely bound the current security guard because more hours would be spent on OU 7. The argument that current health and safety practices preclude considering current occupational scenarios is not valid.

Response: The ecological reserve land use scenario is not currently applicable to the OU 7 area. The most realistic and conservative scenario in the current timeframe is the landfill worker.

Comment 24. **Table 3-4** If current offsite agricultural land use is expected to bound current offsite residential land use as is stated in footnote "c," then why is the residential scenario indicated as "retained for quantitative evaluation" in this table, but not agricultural land use? Section 3.2.1 lists agriculture as a current land use and mentions cattle herds near Rocky Flats Plant. This scenario is considered "plausible" in the future (see Table 3-3). Why hasn't an offsite agricultural family scenario been quantitatively evaluated? Assumptions made under the worker or residential scenarios may not apply to people who live on agricultural property because of differences in length of workday, seasonal changes in work habits, etc. Guidance for exposure parameters to use when considering this scenario are in EPA 1991 (OSWER Directive 9285.6-03). Footnote "h" makes an invalid conclusion. See Comment 21 above.

Response: Cattle grazing occurs near RFP on a irregular, short-term basis. This includes seasonal grazing of beef cattle west of the site and of dairy cattle to the east. The area where cattle are currently grazed east of RFP is at least one mile farther from the site than the nearest current or future offiste resident, further reducing the potential concentration of airborne contaminants. Furthermore, the cattle are not raised and slaughtered for consumption by the local rancher. Therefore, DOE believes that characterizing an offsite (downwind) residential receptor who consumes garden fruits and vegetables is adequately conservative.

Comment 25: **Table 3-4** Footnote "f" assumes no growth in offsite residential land use. As stated in several previous comments, this assumption is invalid. Even if it could be shown that footnote were valid, it will be useful to quantitatively evaluate a future offsite resident. The remedies and controls that could be applied to correct potential onsite residential exposure might not be effective in correcting future offsite residential exposure.

Response: See response to Comment 3 and General Response I.

Comment 26. **Figure 3-7** The receptors listed in the legend should be expanded to include those mentioned in comments above. An exposure point for future offsite residents should be added at a point located on the predominant wind vector emanating from OU 7.

Response: See response to Comment 3.

Comment 27. **Section 3.5.1** Simply because current workers are monitored and protected by current health and safety programs does not mean that current environmental or construction worker scenarios should not be evaluated. Construction workers are exposed to subsoil and possible health risks from that media need to be evaluated.

Response: See General Response IV. The inclusion of information pertaining to health and safety programs currently conducted at RFP is not intended to suggest that a risk assessment will not be conducted for the current onsite landfill worker and a future potential construction worker. The reason for including health and safety information is to support the comparison of potential exposure-point concentrations with those in an industrial setting. These exposure scenarios should be adequate to characterize current exposure and future possible high short-term exposures to workers at the site. The specific assumptions pertaining to exposures incurred by current landfill workers are outlined in Tables 5-1 through 5-5. Exposures potentially incurred by future construction workers will be added to these scenarios and evaluated for OU 7. Appended to this responsiveness summary are tables showing specific exposure for the hypothetical future construction worker.

Comment 28. **Section 3.5.3** DOE has chosen to evaluate a future onsite worker exposure scenario which does not include a future construction worker. In Section 4.5.2.3, a future onsite office worker is chosen to represent this exposure scenario. Some justification for ignoring the future construction worker and evaluating only the future office worker should be made in the text. This restrictive choice will be acceptable

only if the future onsite office worker scenario can be shown to bound the construction worker scenario. The construction worker scenario provides a way to look at more acute exposures via ingestion or dermal contact with subsurface soil and inhalation of soil vapors and dust due to excavations. Section 6.4.2 of "Risk Assessment Guidance for Superfund" (RAGS) recommends that exposure to high concentrations such as occur at hot spots "should be determined for the shortest period of time that could produce an effect." The potential acute hazards (e.g., to VOCs from soil gas) which current landfill workers or future construction workers face should be evaluated as well as the long term hazards. In addition, exposure to subsoil must be considered for both the construction worker and the landfill worker.

Response: A future onsite construction worker will be added to the exposure scenarios. Exposure to subsurface soils will be addressed for this potential receptor, but not for a current landfill worker (see response to Comment 27).

Comment 29. **Section 4.5** The difference between "direct contact" and "wind-blown" routes of exposure is not adequately explained until page 4-12. The conceptual site model, as portrayed in Figure 4-1, would be more clearly understood if this explanation came earlier in the text.

Response: DOE will evaluate direct contact with wind-blown materials for only the offsite receptors. The technical memorandum will be modified so that the explanation of the "direct contact" and "wind-blown" routes of exposure occurs earlier in the document.

Comment 30. **Section 4.5.1** The assumption that "concentrations of radioactive material at or under the surface of the landfill are [not] sufficient to cause significant external exposures from fugitive dust" (p. 4-6) must be justified. The statement ignores documented releases of radioactive materials and precludes any future excavation at the site. The data DOE used to reach this conclusion must be made available for CDH

to review before we can agree that external radiation from wind suspension and subsequent deposition does not need to be quantified.

Response: The statement that measurable releases of radioactive material have occurred is correct; however, associated studies have clearly demonstrated that these releases originated from sources other than OU 7. The text will be revised to better describe the extent of dilution that would result from Gaussian dispersion of resuspended particulates.

Comment 31. **Section 4.5.2.1** The argument in Comment 10 [sic] also applies to chemicals bound to windblown soil. The assumption on page 4-8 that "secondary exposure to soils following wind deposition of particulates is negligible relative to direct exposures to site soils" must be justified. Until supporting data are made available for review, CDH cannot approve this statement.

Response: For onsite (i.e., OU 7) receptors, deposition of resuspended particulates does not represent an additional exposure because the particulates originate at the site. That is, deposition actually represents a replacement rather than an addition of particulates and associated contaminants. Therefore, any exposure associated with the deposition of particulates is included in all direct exposure pathways. The text will be revised to clarify this concept.

Comment 32. **Section 4.5.2.2** In the discussion of mechanisms of plant uptake at the bottom of page 4-9 and the top of page 4-10, DOE must consider plant uptake from wind deposition of metals and organic chemicals as well as surface contamination of plant vegetation. DOE's use of the EPA 1991a reference (Baseline Risk Assessment for California Gulch at Leadville) is misapplied. This risk assessment deals primarily with arsenic, lead, and cadmium. Other metals or chemicals may not bind as tightly to soils as these metals can. In addition, Leadville is in the mountains, with very different soil-types and conditions than those at Rocky Flats, which is at the edge of the foothills. Plant uptake of

chemicals from the soil is very site and soil-type specific because a number of physio-chemical factors can influence this process. Solubility, dissociation or speciation in water, soil-sorption coefficients, cation-exchange ratios, reactivity, including oxidation, reduction, complexation and precipitation all are very dependent on specific site conditions such as pH, organic content of the soil, moisture, etc. Moreover, plant uptake can be both passive (nonmetabolic) and active (metabolic). Active uptake especially of metals can occur against concentration gradients and regardless of how tightly the chemical is bound to the soil. In addition, the ability of different plants to absorb chemicals varies widely depending on the particular environment (Trace Elements in Soils and Plants, A. Kabata-Pendias and H. Pendias, CRC Press, Boca Raton, FL, 1985). Therefore, plant uptake from soil as well as surface contamination of plant vegetation should be considered quantitatively for both offsite residential exposures and onsite exposures.

Response:

See General Response VI. It has been requested by CDH that plant uptake via the roots, along with direct deposition on the foliar parts of plants, be considered quantitatively for not only future onsite residential exposures, but also for offsite residential exposures. DOE believes that conceivable concentrations of OU 7 contaminants in offsite residential gardens would represent an insignificant additional exposure. The reason for this conclusion is the extreme dilution that would occur during aerial transport from OU 7 to the closest offsite resident, and subsequent mixing into the soil during tilling. Dilution due to Gaussian dispersion is estimated to result in an annual deposition rate of less than 100 mg/m^2 of OU 7 particulates on garden soil at the location of the offsite residential receptor. This value is conservative, because the model actually predicts this deposition rate at a distance of one mile from the source; actual values will be tabulated in the Phase I RFI/RI Report. Using a tilling depth of 15 cm and a soil density of 1.2 g/cm^3 results in a total dilution factor of at least 1.8 million for each year's deposition. Assuming that aerially

deposited contaminants accumulate at the same rate for a period of 30 years yields a total dilution factor of at least 60,000. Of course, the use of soil amendments would result in further dilution.

DOE will continue to use root uptake as an additional exposure factor for onsite residential gardens.

Comment 33. **Section 5.0** CDH does not agree with the idea on page 5-2 that "Because contact rates (except for soil ingestion) are approximately proportional to body weight, child residential intakes are not estimated separately for any exposure pathway except soil ingestion, for which children are assumed to have higher daily intake rates." Inhalation exposures are a case in point. Total deposition of air particles in the respiratory tract for children is higher than that for adults (Xu and Yu, *Aerosol Science and Technology*, 5:349-357, 1986). Moreover, children are often the more sensitive populations to a given chemical effect. Therefore, DOE must quantitatively estimate child residential exposures for all exposure pathways, not just for soil ingestion.

Response: See General Response VIII. EPA guidance does not require separate assessment of children except for the direct ingestion exposure pathway. DOE will follow EPA guidance in this technical memorandum.

Comment 34. **Section 5.1.1** Although landfill workers were temporarily on a 3-day/week schedule, they are now at the landfill 5 days a week. This more conservative value should be used for the RME exposure frequency for the current onsite worker.

Response: The risk assessment will incorporate the new information that current landfill workers are now onsite 5 days per week.

Comment 35. **Section 5.1.1** Depending upon the research project, it is likely that an ecological researcher could work all year long. A 16-week field

season is not realistic and not acceptable. Also, the 7-year exposure duration for an ecological researcher used in the intake factor calculations should be listed here if it can be justified. Footnotes in the tables say this number is "based on guidance provided by IAG members." Please reference this guidance.

Response:

See General Response III. DOE's intent was for the hypothetical onsite ecological researcher to be qualitatively different from other onsite workers. In doing so, we have made assumptions that are realistic for the combination of exposure parameters but not necessarily the most conservative for each parameter. We believe that this is the correct approach for two reasons: first, there is no reason to separately address this receptor if it becomes identical to a full-time onsite worker, as CDH seems to be heading; second, using multiple "worst-case" assumptions results in an exposure frequency and duration that are neither reasonable (as appropriate for an RME) nor realistic.

A researcher is not a full-time caretaker. Typically, ecological research would involve a combination of periodic field work coupled with extensive time in the library, office, or laboratory. This work includes reviewing existing literature, compiling the raw data, performing statistical analyses, preparing tables and graphics, and writing text. Recently, Dr. Ward Whicker of Colorado State University, who has performed extensive ecological research at RFP, estimated that a reasonable estimate for a typical researcher at OU 7 would include field work for 4 hours per day, 13 weeks per year, over a period of 2.5 years. Therefore, DOE believes that the assumed values used in the technical memorandum (5 days per week and 16 weeks per year for a period of 25 years) are more very conservative.

Comment 36.

Section 5.1.1 The RME exposure duration for the current landfill worker was assumed to be 5 years based on the assumption that the

landfill will be closed within this period. However, this estimates does not take into account how long the landfill will have to be monitored after closure. Five years is not acceptable; use 25 years instead.

Response:

DOE believes that the appropriate RME exposure duration for the current landfill worker is 5 years. This represents the anticipated active life of the landfill, because CDH and DOE are attempting to cease operations at this unpermitted facility as soon as possible.

DOE feels that it is inappropriate to equate exposures to current landfill workers with exposures during post-closure monitoring because these two activities are extremely dissimilar. In accordance with RCRA regulations, post-closure activities focus on long-term, quarterly groundwater monitoring. Furthermore, the IAG specifies that the groundwater pathway is to be investigated during the Phase II RFI/RI. DOE believes that it is appropriate to evaluate exposures related to post-closure monitoring during the Phase II RFI/RI because the type of Phase I remediation and its affect on groundwater quality cannot be determined at this time and appropriate exposure assumptions for post-closure monitoring cannot therefore be made.

Comment 37.

Section 5.1.2 The assumption on page 5-4 that 25 percent of inhaled particles are deposited in the lung *per se* is true. However, deposition can also occur in other parts of the respiratory tract and exert health effects. Moreover, the same table in the same study that the 25 percent came from also states that 50 percent of inhaled particles are deposited in the upper respiratory passages and subsequently swallowed and retained in the body (MRI, 1985). Because baseline risk assessments are concerned with overall health effects of inhalation and not simply lung effects, the usual value used for depositional fraction is 75 percent. A wide variety of sources indicate that 25 percent is too low a value for depositional fraction. These include the soil dust inhalation estimates of Hawley (*Risk Analysis* 5:(4)289-302, 1985), the International Commission on Radiological Protection (ICRP, 1980)

study which states that for aerosols with a mean aerodynamic diameter between 0.2 μm and 20 μm, the sum of the fractions deposited in the three regions of the respiratory tract varies from about 60 percent to 90 percent, and the US EPA's "Second addendum to air quality criteria for particulate matter and sulfur oxides (1982)", (EPA/600/8-86-020f). If applied at all, a value of 75 percent is recommended.

Response: DOE will use the recommended value of 75 percent for the percentage of inhaled particles that are deposited in the lung.

Comment 38. **Section 5.1.2** (Page 5-4) Any chemical-specific inhaled VOC values for lung retention obtained from the literature must be reviewed and approved by CDH before they can be used. What values will be used if no values can be obtained from the literature? What criteria will be used to evaluate the validity of any literature values?

Response: Chemical-specific information that will be used to calculate RME exposures will be submitted for review and approval prior to inclusion in the Toxicity Assessment Technical Memorandum.

Comment 39. **Section 5.1.3** Fraction ingested (FI) factors, as described on page 5-5, should not be used. The calculation for the future onsite ecological researcher scenario is based on area, not time, and is therefore unacceptable. Depending on the research project, it is entirely conceivable that an ecological researcher could spend the vast majority of time in one area like OU 7 or a small portion of OU 7. Averaging the exposure over the whole RFP buffer zone will essentially dilute out any exposure and is not protective in the remotest sense. In addition, RAGS (6.6.2) suggests that concentrations in indoor dust can be equal to outdoor dust, and therefore the FI should be equal to 1, not 0.5 for the residential scenario.

Response: DOE agrees to base the exposure for the onsite ecological researcher solely on time, not area. See response to Comment 35.

DOE disagrees and will use a fraction ingested (FI) value of 0.5 for the future onsite resident. This assumes that 50 percent of ingested soil or dust originates as contaminated media. See General Response VII.

Comment 40. **Section 5.1.3** Soil matrix values should not be used to modify soil ingestion exposures. The overall usefulness of soil matrix values and the availability of appropriate site-specific and chemical-specific values in the literature are questionable.

Response: For some compounds, the ability of soils to bind the chemical can be significant, especially in its effects on the availability of the compound for dermal exposures. Chemical-specific information regarding the ability of soil to bind compounds so as to reduce their availability for human exposure will be submitted to CDH and EPA for review and approval prior to inclusion in the revised technical memorandum.

Comment 41. **Section 5.1.4** (Page 5-6) A 4-month harvesting season and exposure duration will underestimate potential exposures to contaminated homegrown produce. People not only eat fresh produce, but preserves as well, even in this modern age. A 12-month exposure frequency for homegrown produce should be used instead of a 4-month period.

Response: The exposure assessment will be amended to include a full year exposure duration for consumption of homegrown produce. However, DOE believes that the use of very conservative assumptions concerning the proportion of produce provided by the residential garden is reasonable only if it is also assumed that the resident washes the produce prior to consumption, canning, or freezing. See General Response IX. The assessment will therefore include an evaluation of the amount of soil-bound contaminants that would be expected to be washed off the produce prior to consumption or canning. These values will be consistent with those developed for OU 1. A full justification for the value used will be provided.

Comment 42. **Section 5.1.4** This discussion of homegrown produce ingestion should include fruit as well as vegetables.

Response: The evaluation of potential exposures to site contaminants via ingestion of fruit will be added to the evaluation of current and hypothetical future residential exposures. The specific values for fruit consumption will be the RME value of 42 grams/day, as recommended in the EPA Standard Default Exposure Factors (OSWER Directive 9285.6-03).

Comment 43. **Section 5.1.4** The discussion on page 5-7 of matrix effect on produce bioavailability is unclear. It is not likely that the chemical-specific matrix effect values used for absorption of chemicals to soil will be the same as those for absorption of chemicals to vegetable matter. If this is what was meant, it is unacceptable.

Response: A bioavailability value will not be used to estimate human absorption of contaminants taken up into plants. It is anticipated that much of the exposure to site-related contaminants via ingestion of home-grown produce will be the result of the aerial deposition of soils onto the surfaces of plants. Therefore, DOE will assume that the bioavailibility of contaminants in soil will also apply to contaminants in resuspended soil deposited on plants. See General Response IX.

Comment 44. **Section 5.1.5** The surface area (2,910 cm^2) used for the future ecological researcher and for the future adult resident is too low. It is not reasonable that especially the resident would exposure only the face, forearms and hands (15% of the total body surface). Use the standard default values of 5,800 cm^2 for the residential RME. The use of 2,910 cm^2 surface area for the future ecological researcher probably will underestimate the extent of exposure since it has been shown that some chemicals can permeate through clothing (Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, 1991).

Response: The derivation of the specific value of 5,800 cm^2 suggested in this comment is unknown. Based on information presented in the EPA's Exposure Factors handbook, a typical exposure case (i.e., individual wears long sleeve shirt, pants and shoes) the exposed skin surface is estimated to be 2,000 cm^2. For a reasonable worst case, the Exposure Factors handbook recommends a value of 5,300 cm^2. The most recent guidance in the Interim Guidance for Dermal Exposure Assessment recommends use of the upper end of the range for exposed skin area as 5,000 cm^2 for adults (hands, legs, arms, neck, and head). Because the residential exposure scenario is intended to characterize average exposures over all seasons, this recommended default value of 5,000 cm^2 is conservative for evaluating this exposure scenario. Since a "typical case" exposure is defined to be limited to 2,000 cm^2, DOE believes that assessing the ecological researcher's exposure at 2,910 cm^2 is adequately protective. With regard to the possible permeation of contaminants through clothing, DOE believes that the absence of volatile organic compounds on the target analyte list for OU 7 surficial soils makes this issue moot.

Comment 45. **Section 5.1.5** (Page 5-8) If no data on the percent of specific organic compounds absorbed through the skin are available in the literature, what will be the default values?

Response: DOE plans to evaluate dermal absorption of compounds on a chemical-specific basis, with specific values determined from appropriate, current literature. This information will be submitted for review and approval prior to inclusion in the Toxicity Assessment Technical Memorandum. CDH will have an opportunity to review the methodology and specific values to be used at that time.

Comment 46. **Section 5.1.5** (page 5-8) OSWER directive 9285.6-03 states that exposure parameters such as the average inhalation rate of 20 m^3/day are based on people such as housewives, retired people, invalids, and young children who spend most of their time at home. Therefore, 16

hours spent at home would underestimate the exposures to this population. Moreover, these groups make up the more susceptible portions of the general population. Thus CDH recommends that the fraction contacted (FC) from the contaminated medium be changed from 0.5 for the current and future residential receptors to protect these susceptible populations. The same arguments detailed in Comment 39 above for the FI apply to both the future onsite ecological researcher and the residential receptors. The FC values listed here for these two receptors are not acceptable.

Response: The fraction contacted (FC) value of 0.5 for residential receptors is based on the assumption that half of their time at home is spent in contact with site soils. As described in response to Comment 39, above, DOE agrees to base the exposure of the ecological researcher on time rather than area.

Comment 47. **Tables 5-1 and 5-21** The averaging time used for noncarcinogenic chemicals should be equal to the product of the exposure frequency (days/year) and the exposure duration (years). All the averaging times listed in these tables should be checked and corrected if necessary.

Response: DOE disagrees with this comment. The averaging time (in days), exposure frequency (in days per year), and exposure duration (in years) are correct as shown in the table. EPA evaluates referenced doses for chemicals with noncarcinogenic effects based on chronic exposure of animals to various levels of the chemical being tested. The exposure frequency of an individual who may be exposed to a chemical and subsequent noncarcinogenic hazard index is derived using the reference dose developed from chronic exposure. The individual is exposed on a chronic basis; the time weighted average for exposure is developed for this comparison. The time-weighted average proposed in the tables averages the exposure over an annual basis and should not be averaged over the proposed exposure duration. If a subchronic or acute exposure is expected, a modified dose or acceptable

concentration could be used. The exposure scenario suggested in the risk assessment are for chronic exposure. DOE believes that the averaging time, exposure duration, and exposure frequency values shown in the table are acceptable. This approach also follows EPA guidance on the computation of averaging times.

Comment 48.

Tables 5-1 and 5-5 The various factors used in these tables to reduce RME values are generally unsupported assumptions. Several techniques have been used to "fine-tune" estimates of time spent at the site. The adjustment for snowcover assumes that one inch of snow eliminates all possibilities of dermal contact with soil, soil ingestion, irradiation, etc. The assumption that residents spend only 16 hours/day at home is not supportable by any data. It also does not take the more susceptible populations such as the elderly, invalids, and young children who are more likely to stay at home most of the time into account. Similarly, attempts at determining fractional intake, or limiting homegrown vegetable consumption to 4 months/year are merely assumptions, not supported by any data. Other adjusting factors such as deposition factor, fraction ingested factor, and soil matrix value (Comment 20) have been mentioned above. If any of these factors are applied to the RME values, than an unadjusted RME value must also be reported so that the effect of these adjustments can be evaluated.

Response:

See General Response V. DOE's goal was to follow EPA guidance by establishing reasonable exposure scenarios and risks that represent a 95th percentile of the total maximum probable risk for each receptor. Compounding extreme conservatisms can result in a total exposure that is unrealistic and can inappropriately influence the establishment of cleanup criteria and evaluation of remediation alternatives. DOE believes that the scenarios described in this technical memorandum, as revised, are amply conservative and consistent with EPA guidelines. After the various exposure factors are agreed upon, they will be used to calculate a single, site-specific RME for each exposure scenario.

Comment 49. **Tables 5-1 through 5-21** These tables do not include calculations for the current offsite resident, although that scenario was selected in Section 4 (see Table 4-1) to be quantitatively evaluated.

Response: The missing tables are provided as an attachment to this responsiveness summary.

Comment 50. **Tables 5-1 through 5-21** These tables should be revised to reflect the appropriate modifications requested in Comments 13, 14, 15, 16, 17, 19, 20, 21, 24, 25, 26, 27, 28, and 29.

Response: All tables will be changed to reflect the agreed-upon revisions to the RME calculations.

RESPONSES TO ENVIRONMENTAL PROTECTION AGENCY COMMENTS

Comment 1. **Page 3-26** states that potential exposures to current onsite workers will not be evaluated in the risk assessment, yet the table on page 3-23 shows that it will. This inconsistency needs to be resolved.

Response: Potential exposures for current onsite worker will be included in the risk assessment.

Comment 2. **Page 4-15** lists the pathways of exposure for future onsite residents. Ingestion of groundwater is not included. I realize this is a management call, but this pathway was included (finally) for OU 1.

Response: As dictated in the IAG, the Phase I assessment for OU 7 is limited to characterization of "source and soils." Therefore, characterization of risks associated with exposure to groundwater or surface water will be conducted in Phase II of the RFI/RI process. This is indicated on the Conceptual Site Model (CSM).

Comment 3. **Page 5-3** under General Exposure Assumptions proposes to adjust exposure frequency for snowfall days. This is inappropriate. If the information were being used to determine whether or not someone actually went on the site because of the weather, such as in a recreational or trespassing scenario, this assumption would be correct. However, since residents are expected to live in their housing areas, and workers are expected to come to work regardless of the weather, this assumption is inappropriate. The concept that soil ingestion is limited to outdoor exposure is erroneous. The EPA soil ingestion value is a combination of outdoor soil and indoor dust which can not be divided evenly throughout the day. We have gone into great detail on this subject in my previous comments on OU 1 and OU 2. The exposure frequency for ingestion of soil should remain at 350 days for residential and 250 days for occupational receptors.

Response: As stated in General Response VII and the response to CDH Comment 39, DOE disagrees with the use an FI value of 1.0 and believes that a value of 0.5 is reasonable. DOE also believes that the use of snow cover, which is included in the 0.5 value, is reasonable and appropriate.

Comment 4. **Page 5-4**, second indented paragraph. Current onsite workers should be assumed to breathe onsite air 8 hours per day (not 4 hours), unless the workers will be physically going offsite for the time they are not expected to be outdoors on the site.

Response: The evaluation of exposures for current onsite workers will include the assumptions that they are on the site for 4 hours per day, 5 days per week. The assumption is that the remaining hours are spent offsite.

Comment 5. **Page 5-4**, fifth indented paragraph, states that literature values for the lung retention of chemicals will be used to develop inhalation toxicity factors when inhalation exposure studies are not available. This is generally inappropriate. When inhalation data are insufficient to develop a toxicity value, data from other routes of exposure can be used to derive an inhalation toxicity value, provided that portal-of-entry effects in the lung can be ruled out. This route-to-route extrapolation technique is described in EPA's 1990 "Interim Methods for Development of Inhalation Reference Concentrations" (EPA/600/8-90/066A). The use of lung retention values alone, as described in this technical memorandum, is not appropriate for developing a chemical-specific absorption value. Information on the exposure conditions and pharmacokinetics of the contaminant are also needed and should be evaluated carefully before an absorption value is derived. We suggest that EPA's route-to-route extrapolation method be used when inhalation exposure studies are not available and that the use of lung-retention values be eliminated.

Response: See response to CDH Comment 37.

Comment 6. **Page 5-6**, first indented paragraph, proposes to use a bioavailability factor to reduce the intake of contaminants from ingestion of soil. This factor should be eliminated because the empirical evidence is insufficient at this time, from which to derive bioavailability factors for the chemicals of concern at the Rocky Flats Plant. Region 8 has, however, used reduced bioavailability factors for contaminants (such as lead and arsenic) based onsite-specific geochemical and geophysical characterization of the chemical form present in the soil and in vivo bioavailability studies in animals. If DOE can provide this type of site-specific evidence, we will consider the use of a reduced bioavailability factor. However, until DOE provides this evidence or until further research is conducted in this area, it would be extremely difficult to recommend a factor for bioavailability from soil at this time.

Response: See response to CDH Comment 40.

Comment 7. **Page 5-6**, Section 5.1.4, considers the consumption of homegrown vegetables as a potential route of exposure. Homegrown fruits should also be considered in this pathway. EPA guidance on Standard Default Exposure Factors (OSWER directive 9285.6-03) recommends 42 grams/day as the daily intake rate for homegrown fruits.

Response: See response to CDH Comment 42.

Comment 8. **Page 5-8**, first indented paragraph, proposes to calculate an absorbed fraction for dermal exposure based on data available in the scientific literature. EPA's 1992 Dermal Exposure Assessment: Principles and Applications (EPA/600/8-91/011B) provides suggested values for the dermal absorption fraction of several chemicals/classes of chemicals, as well as guidance on calculating an absorbed fraction for chemicals for which no experimental dermal absorption from soil is available. If absorption fractions are to be used for dermal exposure, we would recommend that the guidance provided in this document be used.

Response: DOE plans to evaluate dermal absorption of compounds on a chemical-specific basis, with specific values determined from appropriate, current literature. This information will be submitted for review and approval prior to inclusion in the Toxicity Assessment Technical Memorandum. EPA will have an opportunity to review the methodology and specific values to be used at that time.

Comment 9: **Tables 5-1 through 5-21** should be revised appropriately to reflect the comments above.

Response: All tables will be revised to accurately reflect changes indicated in this responsiveness summary.

RESPONSES TO PRC COMMENTS

General Comment 1. The intent of Technical Memorandum No. 1 is to identify and describe potential and reasonable maximum exposure scenarios for present and future human receptors in OU 7 and to identify reasonable maximum intake parameters which will be used to estimate chemical intake. Although the memorandum comprehensively identifies exposure scenarios, the intake parameters presented in most of the scenarios fall short of reasonable maximum values conventionally used for Superfund sites. The parameters should be revised to reflect a more conservative approach which will provide consistency with other Superfund sites.

Response: As discussed in General Response V and in a number of response provided earlier, it is DOE's understanding, based on guidance issued by EPA and supported by the Federal Register, that the intent of the risk assessment is to determine a 95th percentile risk. The use of the upper bound value for each assumption in an exposure calculation results in an estimated risk that is far greater than the 95th percentile risk. Therefore, it is reasonable to use adjusted RME values because, when multiplied together, they result in a conservative but reasonable RME value.

General Comment 2. The document asserts that future development of offsite land will be mainly industrial, which is not supported by information presented in the document. This assertion is misleading and conflicts with tables presented in Section 3.0 which indicate a nearly three-fold increase in residential population. Residential development around RFP is currently unrestricted, and master projection plans predict that such development is likely. A future offsite residential scenario has not been included for evaluation but should be considered because this information is essential for risk managers when considering various options for remedial action are considered.

Response: See General Response I and specific response to CDH Comment 2.

General Comment 3. A future onsite construction worker exposure scenario has not been addressed. Future on-site construction workers will have different exposures to site-related contaminants than current onsite workers or future onsite office workers and should be considered for completeness.

Response: See response to CDH Comments 27 and 28. Specific exposure values for the future onsite construction worker are summarized in the tables appended to this responsiveness summary.

Comment 1. **Page 3-21, First Full Paragraph and page 3-23, Table 3-4.** Agricultural land use for offsite areas is described as plausible in the text, but according to Table 3-4 will not be evaluated because it is improbable. This conflict should be resolved. Additionally, the table indicates that current offsite agricultural land use will not be evaluated because the exposure is bound by offsite residential exposures and is likely to decrease in the future.

It would be in the best interest of DOE to consider all possible exposures and not just the upper bound scenarios. If the remedial manager decides not to use upper bound risks, valuable information will not be available.

Rationale: The table conflicts with accompanying text.

Response: See responses to CDH Comments 20 and 21.

Comment 2. **Page 3-25, Second Paragraph.** The text explains in great detail the health and safety programs in place at RFP to protect workers from exposure to chemicals of concern (COCs). This statement is inaccurate. The site has yet to be characterized and COCs have not been identified for OU 7. Moreover, chemical concentrations and

exposures cannot be determined at this time. Thus, health risks from exposure to COCs are currently unknown for OU 7.

Rationale: Health and safety plans are not relevant in a risk assessment.

Response: No exposure scenarios have been omitted from the analysis of OU 7 due to the existence of health and safety plans for workers at the site.

Comment 3. **Page 4-3, Last Paragraph.** The text states "Dermal contact with soil will be assessed quantitatively only if results of OU 7 Phase I sampling programs demonstrate the presence of organic chemicals of concern in surface soil samples at concentrations exceeding background." This approach is inappropriate for three reasons (EPA 1989a). First, all COCs should be evaluated for every appropriate pathway. Second, unlike inorganic chemicals which are naturally present as background, all organic chemicals should be considered anthropogenic. Thus, there are no background concentrations which COCs can be compared to. Third, if organic chemicals are detected in background samples, the selection of the background area will be invalidated because it indicates the area was impacted by RFP activities. Dermal contact should be included in the quantitative assessments.

Rationale: All COCs should be evaluated for all exposure pathways. Organic chemicals should be considered anthropogenic and cannot be eliminated based on comparison to background samples.

Response: Risks will be characterized for all exposure to chemicals selected as chemicals of concern of OU 7. However, not all pathways will be evaluated quantitatively. For example, it is commonly recognized in Region 8 that metals do not translocate across skin; thus, this pathway is not evaluated quantitatively in a risk assessment. Specific information regarding dermal absorption of chemicals will be submitted to CDH and EPA for review and approval prior to inclusion in the

Toxicity Assessment Technical Memorandum. Organics in background samples will be evaluated so that only contamination specifically related to OU 7 is assessed in the Phase I RFI/RI Report.

Comment 4. **Page 4-6, Section 4.5.1.** The text states that external irradiation exposure from wind dispersed radionuclides will not be addressed quantitatively in the risk assessment for any receptor. Exposure to radionuclides from all potential exposure pathways for all receptors identified in the document constitutes a complete analysis and should be quantitatively assessed in the risk assessment for all receptors.

Rationale: All potential exposure pathways should be addressed.

Response: Section 3.5 of EPA's Risk Assessment Guidance for Superfund (RAGS) clearly states that a Human Health Evaluation "should be limited to the complexity and level of detail necessary to adequately assess risks...." Therefore, complete pathways need not be assessed if they are shown to be inconsequential. DOE is following EPA guidance by eliminating the exposure pathway of airborne resuspension and subsequent deposition, which is shown in Section 4.5.1 of the technical memorandum to be negligible.

Comment 5. **Page 4-8, First Full Paragraph.** The description of the second incomplete exposure pathway for current onsite workers is not clear. If the statement is meant to indicate that modeling of particulates in air does not need to be conducted, then data supporting this presumption should be presented.

Rationale: Potential inhalation exposure to current onsite workers is unclear and should be clarified.

Response: See response to CDH Comment 31.

Comment 6. **Page 4-9, Third Paragraph.** Surface deposition of particulates on vegetables is listed as the only contaminant exposure for homegrown vegetable ingestion because plant uptake is expected to be insignificant due to the bioavailability of contaminants and reduced contaminant concentration in offsite soils. Although this may indeed be correct, including plant uptake of chemicals in the soil will complete this exposure pathway and should be included in the quantitative assessment of both fruit and vegetable ingestion for on- and offsite residential receptors (Baes et al. 1984).

Rationale: Complete exposure pathways should be assessed even if their contribution to overall risk is expected to be small.

Response: See response to CDH Comment 32 and General Response IX.

Comment 7. **Page 4-10, First Paragraph.** Ingestion of homegrown fruit is not considered an exposure pathway for current offsite residential receptors, but should be quantitatively assessed for a more conservative and complete assessment of risk (EPA 1989a). Reasonable maximum exposure estimates of homegrown fruit intake are available in Exposure Factors Handbook (EPA 1989b).

Rationale: Ingestion of homegrown fruit should be addressed in the risk assessment.

Response: See response to CDH Comment 42.

Comment 8. **Page 4-12, Section 4.5.2.4.** Surface water contact and incidental surface water ingestion have not been included as exposure pathways for the hypothetical future onsite ecological researcher. Section 2.6.3 indicates that surface water is present on OU 7. Therefore, incidental contact with this water should be assessed. These pathways should also be assessed for future onsite residents, future construction workers, and current onsite workers.

Rationale: Potential exposure pathways from contact with surface water should be addressed in the risk assessment.

Response: As dictated in the IAG, the Phase I assessment for OU 7 is limited to characterization of "source and soils." Therefore, characterization of risks associated with exposure to leachate migration to surface water will be conducted in Phase II of the RFI/RI process. This is indicated on the CSM.

Comment 9. **Page 4-14, First Full Paragraph**. The text states that incidental soil ingestion and dermal exposure from wind-deposited soils will not be included in this assessment because their contribution to risk is expected to be insignificant. If modeling of particulates in air will not be conducted, reasons supporting this decision should be presented.

Rationale: Omitting exposure pathways from the risk assessment should be explained in detail.

Response: See response to CDH Comment 31.

Comment 10. **Page 4-14, First Full Paragraph**. The text indicates that a matrix effect, indicating bioavailability of chemicals in soil, will be used in determining soil intake. Bioavailability factors are chemical-specific and dependent on the particular chemical matrix in which the chemical is ingested. These forms are widely variable for each chemical. Unless sufficient information can be provided to substantiate chemical-specific bioavailability factors, this factor should be eliminated from the soil intake equation.

Rationale: Bioavailability factors vary widely and contribute uncertainty to the intake equations.

Response: See response to CDH Comment 40.

Comment 11. **Page 4-15, Last Paragraph.** Ingestion of homegrown fruit is not considered as an exposure pathway for hypothetical future onsite residents but should be quantitatively addressed for a more conservative and complete assessment of risk (EPA 1989a, 1986). Reasonable maximum exposure (RME) estimates are available from the Exposure Factors Handbook (EPA 1989b). Plant uptake of chemicals in the soil, as well as surface deposition of particulates, should be included in the assessment of fruit ingestion (Baes et al. 1984).

Rationale: All potential exposure pathways should be addressed in the risk assessment.

Response: See General Response IX and previous specific responses to CDH comments.

Comment 12. **Pages 5-2 and 5-3, Section 5.1.1.** Several of the generic exposure assumptions are not consistent with those conventionally used at a Superfund site. The RME exposure frequency of 3 days per week for the current onsite worker is too low. It should be 5 days per week. The RME exposure frequency for the future onsite ecological researcher should be 5 days per week for 50 weeks per year. Exposure frequencies should not be adjusted for snowfall because potential exposures are likely to occur despite ground snow cover. The RME exposure duration for the current landfill worker should be 25 years. To assume that it would be 5 years would impose an institutional control on exposure, which is inappropriate for a risk assessment. These assumptions should be amended because they do not reflect RME conditions.

Rationale: RME values and assumptions should be health-conservative.

Response: See response to PRC General Comment 1.

Comment 13.

Page 5-4, First Indented Paragraph. The inhalation rate of indoor workers should be 0.83 cubic meters per hour. The value listed is not the most conservative RME assumption.

Rationale: Exposure assumptions should reflect RME values.

Response:

The inputs for many of the exposure parameters have been set to upperbound values. As discussed in General Response V, use of the most conservative value for each exposure assumption may lead to an estimate of exposure (and risk) that is unreasonable. Therefore, it is appropriate to use an average value for inhalation rates in order to derive an RME. The value of 0.63 m^3/hour is provided as an average indoor inhalation rate and assumes that an individual spends 48 percent of the time at rest or engaging in light activity, 3 percent in moderate activity, and 1 percent in heavy activity. DOE believes that this mix adequately represents an inhalation rate for a future onsite office worker.

Comment 14.

Page 5-4, Fourth Indented Paragraph. A deposition factor of 25 percent is proposed in the assumptions for inhalation exposure. If 75 percent (EPA 1985) of inhaled particles do not deposit in the lung, they must either be swallowed or expectorated. Ingestion calculations should be adjusted to reflect swallowing of inhaled particulate matter if a deposition factor is used in the inhalation equation. Additionally, deposition factors depend on a number of variables, including aerodynamic particulate diameter and concentration of this fraction in ambient air. Data supporting the deposition factor used in the risk assessment should be provided.

Rationale: Use of a deposition factor should be supported by site-specific data. Intake from ingestion should be adjusted accordingly.

Response:

See response to CDH Comment 37.

Comment 15. **Page 5-5, Last Paragraph.** The text proposes the use of a "fraction ingested from contaminated source" factor to modify soil ingestion based on the amount of time spent outdoors and the size of OU 7 relative to the total area of RFP. The use of this fraction is inappropriate and could underestimate soil intake. The soil ingestion input parameters from Risk Assessment Guidance for Superfund (RAGS) (EPA 1989a) or the Exposure Factors Handbook (EPA 1989b) include ingestion of indoor dust, which should be considered to have contaminant concentrations equal to outdoor soils. A factor for fraction ingested should not be used in determining chronic daily intake from soil.

Rationale: Fractions reducing exposure estimates from soil are inappropriate for RME assumptions.

Response: See General Response VII and response to CDH Comment 39.

Comment 16. **Page 5-6, Section 5.1.4.** Using a 4-month harvesting season to reduce the intake of homegrown vegetables is inappropriate. The RME value for ingestion of vegetables is 80,000 mg/day (EPA 1989b) based on a typical consumption of 200,000 mg/day and RME proportion of 40 percent of vegetables being homegrown. The RME value should be used to determine contaminant intake through this pathway.

Rationale: RME values should be used to determine contaminant intake.

Response: See response to CDH Comments 41 and 42.

Comment 17. **Page 5-7, First Indented Paragraph.** The use of a matrix factor to account for bioavailability of contaminants in homegrown produce is inappropriate. Particulates deposited on the surface of a plant are not covalently bound and should be assumed to be available for absorption by the gastrointestinal tract. Although it is possible that contaminants

taken up by plants are less bioavailable than particulates on the surface of plants, very little information regarding this issue is available. Therefore, a reliable matrix factor cannot be estimated and should be eliminated from the intake equation.

Rationale: The matrix factor is inappropriate for ingestion of contaminants from homegrown produce.

Response: See response to CDH Comment 42.

Comment 18. **Page 5-7, Section 5.1.5.** The value used to represent RME exposed body surface area is not consistent with the value conventionally used for residential receptors. Residential receptors are not likely to wear long sleeves and long pants when gardening in their yards and therefore would have more body surface area exposed than indicated. This body surface area value should be increased for both on- and offsite residential receptors. EPA's Dermal Exposure Assessment: Principles and Applications (EPA 1992) provides more acceptable body surface area estimates.

Rationale: The body surface area value presented is not an RME estimate for residential receptors.

Response: See response to CDH Comment 44.

Comment 19. **Page 5-8, Second Paragraph.** The soil adherence factor listed is the midpoint of recommended values, but it is not the RME value. The RME value, as suggested by the Dermal Exposure Factors Handbook (EPA 1992) is 1.0 milligram per square centimeter (mg/cm^2).

Rationale: The proposed soil adherence factor is not an RME value.

Response: As with other parameters, and in the spirit of EPA's exposure assessment guidance, the goal was to achieve a conservative final

value, not to use the most conservative value for each parameter. See General Response V. Therefore, DOE believes that 0.5 mg/cm^2 is the correct soil adherence factor.

Comment 20. **Page 5-8, Last Paragraph.** As described in specific comment 15, the use of a fraction ingested factor is inappropriate and should be eliminated from the equation.

Rationale: See specific comment 15.

Response: DOE will use an FC value of 0.5 for both the current landfill worker and future onsite office worker exposure scenarios. For current landfill workers, an FC of 0.5 is conservative because they are onsite only 4 hours per day. The rationale for using an FC of 0.5 for the future onsite office worker is the same as that described earlier for the future onsite resident (see response to CDH Comment 46). Even if they were present onsite for 24 hours per day, DOE assumes that they would be in contact with contaminated media for half of the time. See General Response V. The FC value for the ecological researcher will be determined within the context of the scenario agreed upon. DOE will us an FC of 1.0 if the scenario outlined in response to CDH Comment 35 is adopted.

If the comment was directed to the last paragraph of page 5-5, concerning FI values, see General Response VII and responses to CDH Comment 39.

Comment 21. **Pages 5-11 through 5-31, Tables 5-1 through 5-21.** The summary tables reflect the inaccuracies noted in the text and should be corrected.

Rationale: The tables should be modified to incorporate changes made in the text.

Response: See response to CDH Comments 49 and 50.

Comment 22. **Page 5-21, Table 5-11.** The soil ingestion rate for the hypothetical future onsite ecological researcher underestimates potential exposure. An ingestion rate of 100 milligrams per/day is the acceptable value for this receptor (EPA 1989a, 1989b).

Rationale: The soil ingestion rate presented for the ecological researcher is not conservative.

Response: The value of 50 mg/day was taken from EPA 1991b (Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance, "Standard Default Exposure Factors." OSWER Directive 9285.6-03, March 25, 1991).

Comment 23. **Page 5-25, Table 5-15.** The "fraction exposed from contaminated surface" should be eliminated from this equation. This factor is being used in a manner similar to the fraction of soil ingested from a contaminated source (see specific comment 15) and is incorrect for similar reasons. It is incorrect to assume that exposure depends on the size of the area relative to the total size of the RFP buffer zone. Exposure should be dependent on the amount of time spent in the area, which in this case is 8 hours per day.

Rationale: Fractions reducing exposure estimates are inappropriate for RME assumptions.

Response: See response to CDH Comment 39.

Inhalation of Particulates
Hypothetical Future Construction Worker

$$\text{Intake Factor} = \frac{IR \times ET \times EF \times ED \times DF}{BW \times AT}$$

Parameter	RME
IR = Inhalation rate (m^3/hr)[a]	1.4
ET = Exposure time (hours/day)	8
EF = Exposure frequency (days/year)	30[b]
ED = Exposure duration (years)	1.0
DF = Deposition factor[c]	0.75
BW = Body weight (kg)	70
AT = Averaging time (days)	
Noncarcinogenic	365
Carcinogenic	25,550

(a) Recommended average value for an outdoor worker (EPA 1989b).

(b) Based on the expected number of days required to construct a building foundation.

(c) Based on assumption that 75 percent of inhaled particles are deposited and remain in the lung; it is assumed that all of the chemicals in that fraction are absorbed (MRI 1985).

Soil Ingestion
Hypothetical Future Construction Worker

$$\text{Intake Factor} = \frac{IR \times FI \times ME \times EF \times ED \times CF}{BW \times AT}$$

Parameter	RME
IR = Ingestion rate (mg/day)[a]	50
FI = Fraction ingested from contaminated source	1.0
ME = Matrix effect[b]	chemical-specific
EF = Exposure frequency (days/year)	30[c]
ED = Exposure duration (years)	1.0
CF = Conversion factor (kg/mg)	10^{-6}
BW = Body weight (kg)	70
AT = Averaging time (days)	
Noncarcinogenic	365
Carcinogenic	25,550

(a) Source: EPA (1991b). Supersedes EPA (1989a).

(b) The matrix effect describes the reduced availability due to adsorption of chemicals to soil or food compared to the same dose administered orally in solution. Therefore, the soil matrix has the effect of reducing the intake of the compound. A matrix effect value of 1.0 is used unless chemical-specific data are available.

(c) Based on the expected number of days required to construct a building foundation.

Dermal Contact with Surface Soil
Hypothetical Future Construction Worker

$$\text{Intake Factor} = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

Parameter	RME
SA = Surface area (cm_2)[a]	2,910
AB = Absorption factor[b]	chemical-specific
AF = Adherence factor (mg/cm^2)[c]	0.5
FC = Fraction contacted from contaminated source	1.0
EF = Exposure frequency (days/years)	30[d]
ED = Exposure duration (years)	1.0
CF = Conversion factor (kg/mg)	10^{-6}
BW = Body weight (kg)	70
AT = Averaging time (days)	
Noncarcinogenic	365
Carcinogenic	25,550

(a) The RME surface area is equivalent to face, forearms, and hands, or 15 percent of total body surface (EPA 1989b).

(b) Absorption of metals from a soil matrix is negligible (EPA 1991a). The absorption factor for semivolatiles, volatiles, and other organics is likely to be lower and will be determined on a chemical-specific basis.

(c) Source: Sedman (1989).

(d) Based on the expected number of days required to construct a building foundation.

Soil Ingestion, Current Offsite Resident (Adult and Child)[a]

$$\text{Intake Factor} = \frac{IR \times FI \times ME \times EF \times ED \times CF}{BW \times AT}$$

Parameter			RME	
			Adult	Child
IR	=	Ingestion rate (mg/day)[b]	100	200
FI	=	Fraction ingested from contaminated source[c]	0.5	0.5
ME	=	Matrix effect[d]	chemical-specific	
EF	=	Exposure frequency (days/year)[b]	350	350
ED	=	Exposure duration (years)[b]	24	6
CF	=	Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW	=	Body weight (kg)	70	15
AT	=	Averaging time (days)		
		Noncarcinogenic	8,760	2,190
		Carcinogenic	23,360	2,190

[a] The calculation of a 30-year residential exposure to soil is divided into two parts. First, a six-year exposure duration is evaluated for young children, and this accounts for the period of highest soil ingestion (200 mg/day) and lowest body weight (15 kg). Second, a 24-year exposure duration is assessed for older children and adults by using a lower soil ingestion rate (100 mg/day) and an adult body weight (70 kg). These two periods are then time-averaged (EPA 1991b).

[b] EPA-recommended value (1991b).

[c] The RME (FI) assumes that residents are in contact with contaminated soils 50 percent of their time at home.

[d] The matrix effect describes the reduced availability due to adsorption of chemicals to soil compared to the same dose administered in solution. Therefore, the soil matrix has the effect of reducing the intake of the compound. These values are chemical-specific.

Ingestion of Homegrown Vegetables (Surface Deposition of Particulates), Current Offsite Resident

$$\text{Intake Factor} = \frac{IR \times FI \times ME \times EF \times ED \times CF}{BW \times AT}$$

	Parameter	RME
IR:	Ingestion rate, vegetables (mg/day)[a]	200,000
FI:	Fraction ingested from contaminated source[b]	0.4
ME:	Matrix effect	chemical-specific
EF:	Exposure frequency (days/year)[c]	350
ED:	Exposure duration (years)	30
CF:	Conversion factor (kg/mg)	10^{-6}
BW:	Body weight (kg)	70
AT:	Averaging time (days)	
	Noncarcinogenic	10,950
	Carcinogenic	25,550

[a] This ingestion rate is based on the typical consumption value of vegetables (EPA 1991b).

[b] "Reasonable worst case" proportion that is homegrown of 40% (EPA 1991b)

[c] Source: EPA (1991b). Conservatively assumes that homegrown produce is consumed year-round.

Inhalation of Particulates, Current Offsite Resident

$$\text{Intake Factor} = \frac{IR \times ET \times EF \times ED \times DF}{BW \times AT}$$

		Parameter	RME
IR	=	Inhalation rate (m^3/hr)[a]	0.83
ET	=	Exposure time (hours/day)[b]	24
EF	=	Exposure frequency (days/year)[c]	350
ED	=	Exposure duration (years)[c]	30
DF	=	Deposition factor[d]	0.75
BW	=	Body weight (kg)	70
AT	=	Averaging time (days)	
		Noncarcinogenic	10,950
		Carcinogenic	25,550

[a] This is equivalent to 20 m^3/day (EPA 1991b).

[b] This RME exposure time assumes that 24 hours per day is spent at home.

[c] Source: EPA (1991b). Assumes that exposure point concentrations account for precipitation, and are provided on annual-average basis.

[d] Based on 3/12/93 guidance from CDH.

Inhalation Of VOCs, Current Offsite Resident

$$\text{Intake Factor} = \frac{IR \times ET \times EF \times ED \times AF}{BW \times AT}$$

Parameter			RME
IR	=	Inhalation rate (m^3/hr)[a]	0.83
ET	=	Exposure time (hours/day)[b]	24
EF	=	Exposure frequency (days/year)[c]	350
ED	=	Exposure duration (years)[c]	30
AF	=	Absorption Fraction	chemical-specific
BW	=	Body weight (kg)	70
AT	=	Averaging time (days)	
		Noncarcinogenic	10,950
		Carcinogenic	25,550

[a] This is equivalent to 20 m^3/day (EPA 1991b).

[b] This RME exposure time assumes that 24 hours per day are spent at home.

[c] Source: EPA (1991b).

Dermal Contact With Surface Soil, Current Offsite Resident

$$\text{Intake Factor} = \frac{SA \times AB \times AF \times FC \times EF \times ED \times CF}{BW \times AT}$$

		Parameter	RME
SA	=	Surface area (cm^2)[a]	5,000
AB	=	Absorption factor[b]	chemical-specific
AF	=	Adherence factor (mg/cm^2)[c]	0.6
FC	=	Fraction contacted from contaminated source[d]	0.5
EF	=	Exposure frequency (days/year)[e]	350
ED	=	Exposure duration (years)[e]	30
CF	=	Conversion factor (kg/mg)	10^{-6}
BW	=	Body weight (kg)	70
AT	=	Averaging time (days)	
		Noncarcinogenic	10,950
		Carcinogenic	25,550

[a] Based on EPA Interim Guidance for Dermal Exposure Assessment (hands, legs, arms, neck, and head).

[b] Absorption of metals from a soil matrix is negligible (EPA 1991a). The absorption factor for semivolatiles, volatiles, and other organics is likely to be lower than 100% and will be determined on a chemical-specific basis.

[c] This is a median value from the range (average to upper estimate) for soil adherence values recommended by EPA (1992b).

[d] The FC assumes that residents are in contact with chemical-containing media 50 percent of their time at home.

[e] Source: EPA (1991b).